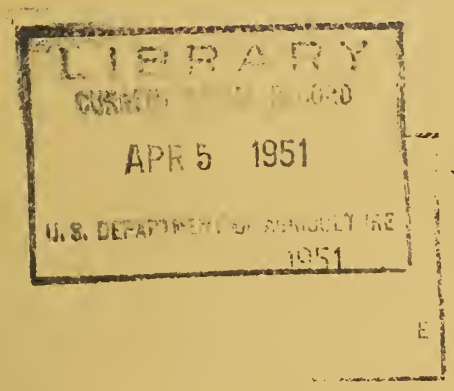
# St. JOHNSWORT ON WESTERN RANGES

by

Grant A. Harris

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# ST. JOHNSWORT ON WESTERN RANGES

(A review of literature and bibliography)

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# C O N T E N T S

## INTRODUCTION

Control of noxious and poisonous range plants has become a major problem on western grazing lands. It has not always been so. When white men first began to use the ranges for livestock grazing the hazard of plant poisoning was relatively remote. However, today as a result of many years of grazing use and in some cases misuse, the native range cover includes a greater abundance of poisonous and noxious plant species. Some of these undesirable species are natural components of the native range vegetation, perhaps now out of balance, while others have been introduced from foreign countries.

One of the most aggressive of the noxious range plant invaders is St. Johnswort (Hypericum perforatum), a weed introduced from Europe. In the West St. Johnswort has invaded more than two million acres of once valuable grazing land and is still spreading. Under certain conditions it is poisonous, and although animals seldom die from its toxic effects, losses in weight and condition often result. Its most objectionable feature, however, is its ability to crowd out valuable forage plants once it gains a foothold through disturbance, and thus reduce range grazing capacity. In many cases it has become well established before range administrators or ranchers were aware of its presence. Once fully established, complete eradication is not feasible. Because of its actual or potential threat to grazing land values a careful review of what is known about the plant and its control is presented herewith.

## CHARACTERISTICS OF ST. JOHNSWORT

### RECOGNITION FEATURES

The common name, St. Johnswort, comes with the plant from Europe where according to legend it bloomed on June 24, St. John the Baptist's Day. Other common names include Klamath weed, goatweed, Tipton weed, and Chinaweed (67, 41).

St. Johnswort is a perennial plant which commonly grows in dense patches, almost to the exclusion of other herbaceous vegetation (Figure 1). It reaches a height of from one to three or more feet, depending on the quality of the site. Numerous bright yellow flowers are produced on a many-branched stem or cyme, usually from June through August (Figure 2). They are about 3/4-inch in diameter, have five short green sepals, five separate petals, and many stamens which are united into three to five clusters. The yellow petals have numerous black dots around the edges. Flower parts wither and remain attached to the ovary after maturity, giving the plant a ragged appearance. The ovary develops into a three-celled capsule, which remains upright and usually cracks open at the top after seed maturity.

Figure 1. A typical stand of St. Johnswort near Colville, Washington, photographed in early June, 1950. The numerals are approximately five inches tall.

Figure 2. A detailed drawing of St. Johnswort. (From U. S. Forest Service Range Plant Handbook.)

In the fall and early spring many short, leafy, flowerless stems are produced. Some of these later develop into flowering stems which are rust colored and woody at the base but green and herbaceous above. After curing, the whole plant has a rusty brown cast and patches of it can thus be recognized from long distances. Stems of young plants are slightly flattened. Leaves average about 3/4-inch in length and 1/4-inch in width. Basal leaves are larger, upper ones smaller. They occur in pairs on opposite sides of the stem, are stalkless or sessile, and pointed on the ends. Small glands resembling tiny pin holes and which produce the toxic substance in the plant are located on the under side of the leaves. The plant is easily recognized by these holes, which may be seen readily when a leaf is held up to the light. St. Johnswort has an extensive root system, many branches of which feed in the surface two to three feet of the soil.

Reproduction is by both seed and roots. New plants originate at intervals along underground root runners which may extend three feet or more from the parent plant. Seeds are about the size of small clover seed, twice as long as they are thick, dark brown, cylindrical, pointed on the ends, and are seen to be pitted if viewed under a hand lens. They remain viable in the soil for at least 10 years (7). They are usually produced in abundance. Up to 60,000 have been counted from a single plant. Neither flowers nor seed are produced by first-year seedlings (6, 9, 37, 40, 56, 67).

## POISONOUS QUALITIES

St. Johnswort produces a drug, hypericin, which is toxic to most grazing animals. The poison causes severe irritation to white animals or animals with patches of white skin or hair when exposed to direct sunlight. Animals may be affected either by eating or simply by touching the plant. Ingestion of an amount equivalent to only five percent of the body weight has caused death in cattle. First symptoms of poisoning are uneasiness and increased respiration, pulse, and temperature. Later, blisters and a scab condition may develop over the ears, face, back, and sides. In severe cases animals develop sore mouths and may even become blind. Cattle are more susceptible to St. Johnswort poisoning than sheep. Affected animals seldom die, but lose weight and market value (42).

(Pages 2a and 2b follows)


Figure 1. A typical stand of St. Johnswort near Colville, Washington, photographed in early June, 1950. The numerals are approximately five inches tall.

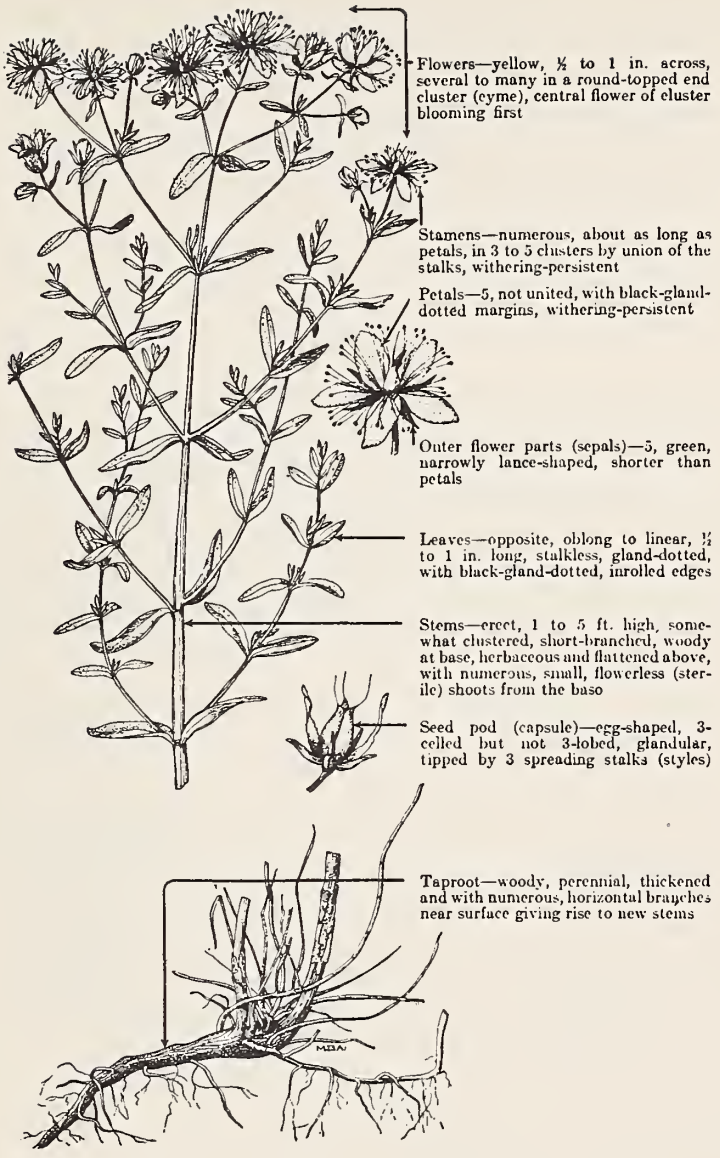


Figure 2. A detailed drawing of St. Johnswort. (From U. S. Forest Service Range Plant Handbook.)

## DISTRIBUTION

St. Johnswort occurs naturally in Europe, North Africa, India, northern and western Asia, China, and Japan (65). In addition it has become well established in Australia, the United States, and Canada. The first known reference to the presence of this noxious weed in the United States was made by H. Muhlenberg in "Index florae lancastriensis," (44), dated 1793, and several others noted its presence on the east coast during the early and middle 19th century. Some authors believe that St. Johnswort seed came to the west coast with the earliest pioneers, but the first record of its collection in that area was at Vancouver in 1899 (49). Soon after this, about 1905, it attracted much attention on the Klamath River in northern California and southern Oregon.

There are now two major regions of St. Johnswort infestation in the west; (a) the coastal region, including northern California, western Oregon, and western Washington, and (b) the interior region, which includes northeastern Oregon, eastern Washington, northern Idaho, and northwestern Montana (see Figure 3). A recent estimate, based on information furnished by state agricultural experiment stations and the United States Forest Service, indicates that more than two million acres of western range land are now infested with St. Johnswort:

| State | Estimated area (acres) |
|---|---|
| California | 400,000 |
| Colorado 1/ | |
| Idaho | 400,000 |
| Montana | 154,000 |
| Nevada 1/ | |
| Oregon | 1,250,000 |
| Washington | 200,000 |
| Total | 2,404,000 |

Figure 3. Distribution of St. Johnswort in the western range states.

1/ Present in very small acreages.

(Page 3a follows)

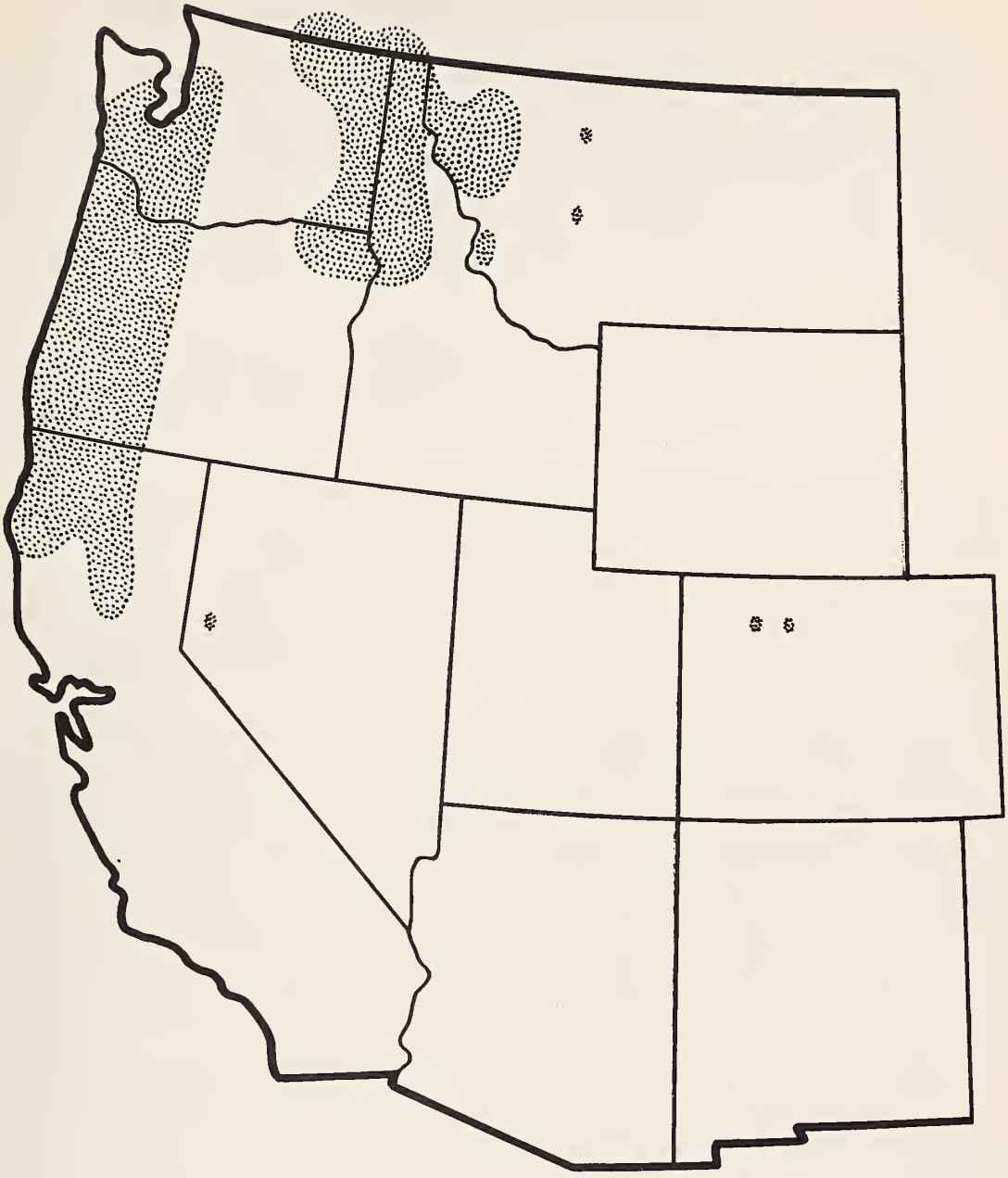

Figure 3. Distribution of St. Johnswort in the western range states.

## ECOLOGICAL SIGNIFICANCE OF ST. JOHNSWORT

In southern France, where St. Johnswort is indigenous, it is characteristic of the second weed stage of plant succession (65). There it is one of the first weeds to invade disturbed areas, such as abandoned fields, burns, roadside clearings, and embankments, but if left alone will eventually yield to other weeds which in turn will be followed by shrubs and trees. St. Johnswort has been reported to invade stands of alfalfa in southern France, rendering the crop worthless.

In France, insects which feed on various parts of St. Johnswort plants are important ecologically (65). As the density of the weed increases, insect populations build up until temporary control of the weed may become a reality.

Closed canopies of taller vegetation prevent the growth of St. Johnswort because it is intolerant of shade (65). On newly infested, open forest lands, the shade circles of trees are definitely marked by an absence of the weed. Competition for moisture under trees is no doubt a cause contributing to the circles, but shade appears to be the most important. St. Johnswort is not a problem on lands which are cultivated annually (56).

The precise ecological relationships of St. Johnswort on the ranges of western United States are in dispute. Sampson and Parker (56) noted that "The plant (St. Johnswort) typically secures a foothold on denuded slopes and semi-exposed soils," but they also noted that "On open grassland it competes successfully with all types of herbaceous vegetation, including even sod grasses. Destruction of the grasses is caused by shading, root competition and insufficient soil moisture." "Such excellent forage plants as California oatgrass ... ... although eventually crowded out, are among the last to be replaced." Robbins and associates (54) in discussing this subject stated: "... ... there is no indication that a complete abandonment of Klamath weed infested range land in the northern counties of California (where infestations are 40 to 50 years old) will result in a return to the initial state. On the contrary, most of the abandoned areas become almost completely covered with Klamath weed and continue in this condition for many years." But Jenkins and Jackman (37) speaking of control in Oregon, recommended: "If possible infested areas should be seeded to good, sod-forming cultivated grasses such as bentgrass or Kentucky bluegrass. St. Johnswort does not thrive nor spread in good stands of grass." Further research is needed to determine which native or cultivated grasses can compete successfully with the weed, and whether good grazing management will allow certain grasses to displace it.

The known elevational range of St. Johnswort is from sea level to approximately 5,000 feet altitude in northern California (56). The short growing season above 5,000 feet is apparently a limiting factor. High mountain passes have sometimes been considered effective barriers to the spread of St. Johnswort, but in many cases where these passes are traversed by highways, railroads, or livestock trails the seed has been carried across.

Moisture requirements of St. Johnswort are poorly understood. Where winter precipitation occurs in the form of rain, as in much of California, 35 to 40 inches of annual precipitation are required. But in regions of heavy winter snows, as little as 10 or 12 inches annual precipitation seem to be sufficient. In areas receiving less than 10 inches annual precipitation it invades drainageways where soil moisture is more abundant. However, St. Johnswort does not do well on poorly drained sites (56, 65).

The usual variations in soil texture or acidity do not limit the growth of this weed except that it prefers slightly acid soils (56). In laboratory tests, Sampson and Parker found that "... plants developed much more vigorously in a slightly acid medium (pH 6) than in alkaline cultures..." They concluded that "... the plant prefers at least slightly acid soils and may not become serious on soils of medium to high alkalinity..." It tolerates a rather wide range of soil fertility. In Washington, dense stands have become established on eroded, infertile areas of Waits' gravelly silt loam and on Springdale coarse sandy loam as well as on fertile valley-bottom pasture land.

St. Johnswort quickly invades areas suitable for its growth once they are disturbed. The myriads of tiny seeds produced are scattered over wide areas. These seeds have a sticky covering which causes them to adhere to the coats of animals, feet of birds, etc., and they are often transported in hay or grains used for feed or seed. Maps of active invasions readily show that livestock driveways, highways, and railroad rights-of-way are the principal travel routes. Once pioneer plants become established, the stand of St. Johnswort thickens and the native plant cover decreases.

It is clear that the two million acre infested area in the West today is small compared to what it may soon be unless economical control methods are developed and generally applied.

## CONTROL AND ERADICATION OF ST. JOHNSWORT

Complete eradication of St. Johnswort on western range lands now seems an impossibility. The extensive area of rough, inaccessible land now infested is not susceptible of treatment by proven control methods. Efforts, therefore, should be aimed at control of the weed on the most accessible sites.

Control measures are strictly limited by high per acre costs, inaccessibility, and rough topography of the infested ranges. The extensive use of heavy equipment or costly chemicals is thus limited to special cases. An effective method must include provision for the control of subsequent seedling crops from seed stored in the soil as well as the mature plants present at the time of treatment. Characteristics of the weed and the land which it infests greatly complicate the control problem.

After St. Johnswort has been controlled on a given site by any method, the soil surface is left almost bare of vegetation (36, 56). The effectiveness of control and the grazing capacity of the range will both be improved if the site is promptly reseeded to good forage plants (2, 45). Reseeding on small experimental areas following removal of St. Johnswort has been highly successful.

## MECHANICAL CONTROL METHODS

Mechanical methods of controlling St. Johnswort, such as hand pulling and hoeing, were tried in the early days but were found to be effective only on very small areas. The expense of these methods is great and they must be repeated each year indefinitely to destroy new crops of seedlings. On high value land that is not too steep for equipment operation farm implements, such as plows and cultivators, have been used effectively. For most range lands, however, such methods are impractical. Mowing stimulates root growth and thickens the stand, but is a useful means of preventing seed production on small patches. Flooding is not practical because very little range land can be flooded and immersion in water does not destroy the seed. Neither does burning destroy St. Johnswort. In fact, seed germination may be stimulated by fire (56).

## CHEMICAL CONTROL METHODS

Numerous chemicals have been used effectively to kill St. Jehnswort, but all those discovered to date have one or more serious limitations. They must be evenly spread over infested areas to be effective and on range lands this usually can be accomplished only by the use of expensive hand labor. Even if the material were cost free, the expense of spreading it by hand would, in many cases, be greater than the grazing value of the range land. Chemicals are usually manufactured or refined at a central location remote from the ultimate place of use. Manufacturing and freight charges combine in many cases to make them prohibitive. The few chemicals which are relatively inexpensive or can be spread cheaply by aircraft generally are only temporarily effective and are not economical in the long run. Others which are effective in controlling St. Johnswort are poisonous to livestock or highly inflammable and therefore should not be used on grazing lands.

Chemical control on two million acres is impracticable, but chemicals can be useful in the holding operation. Small spot infestations which are found in otherwise clean areas can be economically and successfully controlled in this manner.

Of the soil sterilizing materials tested so far boron compounds have been most practical. St. Johnswort seems to be especially sensitive to high concentrations of boron, but most forage grasses are tolerant of amounts required to kill the weed. Borascu, a relatively cheap unrefined borate ore, has been commonly used. This product is only moderately soluble in the soil. In semi-arid climates it remains for several years in concentrations great enough to kill seedlings which may subsequently come from seed stored in the soil. This delayed effect is very important and explains part of the success of borascu in controlling St. Johnswort (39, 52).

Borascu has been widely tested by research and action agencies throughout the infested region. Recommended rates of application range from 4 to 10 pounds per square rod (640 to 1,600 pounds per acre) depending on precipitation and soil texture. Heavy soils in areas of low rainfall require large dosages. Lighter soils require less. Borascu is most effective when it has leached into the plant root zone by the early part of the growing season. Usually about 10 inches of precipitation are required to do this. Therefore, if it is applied in early spring, May and June precipitation, in the Northwest, will ordinarily be sufficient to carry it downward to an effective depth in the soil.

Borascu is usually spread by hand in the dry crystalline form. One man can treat from two to four acres of steep range in an eight-hour day by hand provided that the bags of borascu have been previously set out at proper intervals. Application can be facilitated by use of a cyclone broadcaster. (See Figure 4.) The borascu treatment costs from about $15 to $50 per acre depending on such factors as rate of application, accessibility of the area, topography, etc.

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Figure 4. Borascu can be broadcast on rough St. Johnswort infested range lands by use of a grass seeder.

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Sodium chlorate was recommended by Sampson and Parker (56), while sodium and calcium chlorate were both recommended by Lommasson (41). Raynor found sodium chlorate too hazardous to use, because it rendered organic matter highly inflammable and was poisonous to livestock. He recommended a mixture of borate ore (8 parts) and sodium chlorate (1 part), which he found very toxic to St. Johnswort and safe to use. This mixture is more expensive than borascu alone. Raynor also found that sodium arsenite applied as a spray killed the

(Page 7a follows)

Figure 4. Borascu can be broadcast on rough St. Johnswort infested range lands by use of a grass seeder.

existing plants and prevented seedling establishment for some time. However, sodium arsenite is expensive, highly poisonous to livestock, and it sterilizes the soil for several years. The Australians have found that common salt was effective but six tons per acre were necessary for control (9, 14). Transportation and scattering of the salt, and the loss of soil productivity for several years were major items of expense in this treatment. Ammonium sulfamate (Ammate) gives excellent control (2) but costs about $50 to $100 per acre for the chemical alone.

Recently the ester form of 2, 4-D [2/] and 2, 4, 5-T [3/] have been applied to St. Johnswort and favorable results have been achieved. One and a half to two pounds acid equivalent of 2, 4-D isopropyl ester per acre has given satisfactory control in California, if applied in the spring when young stems are four to six inches tall (51). However, unpublished studies conducted by the Washington Agricultural Experiment Station in eastern Washington and the Idaho Agricultural Experiment Station in northern Idaho, show that 2, 4-D is only partially effective on St. Johnswort in the interior region. In these studies, old plants were killed but seeds stored in the soil germinated and a new stand of St. Johnswort seedlings was reestablished before reseeded grasses became established. Repeated annual treatments with 2, 4-D may eventually control St. Johnswort, but this would be an expensive process. There seemed to be no residual toxicity to control seedlings as with borascu. Treatment with 2, 4-D in water solution costs $5 to $15 per acre at present prices, depending on rate and method of application and accessibility of the area. This is generally more economical than borascu for a single treatment. Even so, use of borascu is often justified for its lasting effect beyond one year and because it can be applied in more than one season of the year (39).

Borthwick (8) found that calcium retarded germination of St. Johnswort seed and suggested that calcium might be used to help control the recurrence of seedlings after the initial treatment.

## CONTROL BY GRAZING ANIMALS

Unsuccessful attempts have been made to control St. Johnswort by forcing livestock to graze it heavily (56). In these forced grazing trials the few desirable forage plants were injured thus giving an even greater advantage to the St. Johnswort. Also, the livestock suffered from lack of nutritious, palatable forage.

Sampson and Parker (56) found that goats would readily graze succulent leafage of St. Johnswort, even though it was mildly poisonous to them. Such grazing use helped to curb the spread of the weed into uninfested

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2/ Dichlorophenoxyacetic acid.
3/ Trichlorophenoxyacetic acid.

ranges, but they pointed out that "... ... using goats extensively involves new methods in the whole plan of livestock production." Goat grazing is not an important phase of range livestock production in the West and has not been an important factor in the control of St. Johnswort.

Marsh and Clawson (42) found that infested ranges could be grazed lightly by dark colored animals without serious loss of stock. This practice has also been successfully followed in Australia (43), where dark colored dairy cattle as well as lambs with dark muzzles and points have been grazed without injury on St. Johnswort infested ranges. On western Oregon ranges, where the weed abounds, a shift from cattle to sheep is slowly being made because sheep seem to be able to graze infested ranges with less injury. This practice does not remove the need for controlling St. Johnswort but only simplifies living with it. St. Johnswort will continue to cause large reductions in grazing capacities and losses in livestock weights even though infested ranges may be grazed more satisfactorily by sheep than cattle.

## CONTROL BY COMPETING VEGETATION

In Australia, attempts have been made to control the weed by planting infested areas to competing vegetation (4, 21, 43, 58). Plantations of Monterey pine on infested land shaded St. Johnswort out, but in natural openings and on firebreaks the weed grew profusely. Subterranean clover successfully held out the weed on prepared land, but only under careful management including light grazing and the application of 200 pounds of super phosphate per acre. Grasses and other legumes were not so effective.

## CONTROL BY INSECTS

The most promising line of attack yet initiated is the use of insect parasites to destroy St. Johnswort. Numerous species of insects which feed exclusively on St. Johnswort have been found in England and France. Some of these have been introduced into the western range states and are now well established in certain areas.

Entomological control of St. Johnswort promises to be much cheaper than other methods giving similar results (35, 65). After initial establishment, the adapted insects continue to work, multiply, and spread to other infested areas.

Probably the best known example of entomological control of plants is the case of pricklypear in Australia (25). Pricklypear was introduced from the United States into Australia where, being free of its natural enemies, it soon ruined the grazing value of 30 to 60 million acres of range land. The moth, Cactoblastis cactorum, was introduced and in a few years controlled the pricklypear. This weed is no longer

a serious problem in Australia. In Hawaii lantana (Lantana camara) was controlled by introduced seed-eating insects which prevented the production of viable seed (47). Many other instances of entomological control of plants are recorded in the literature (36, 65).

Australian entomologists have led the field in biological research in the control of St. Johnswort (3, 18, 19, 30, 31, 64, 65, 66). They discovered 37 different species of insects in Europe which feed on St. Johnswort to some degree. These were classified as shoot galls, root galls, leaf rollers, root borers, leaf eaters, sap suckers, leaf miners, stem miners, leaf webbers, seed capsule borers, and flower eaters (65). After appropriate tests to insure that the insects would not attack commercial crops, colonies of seven species were released inAustralia, beginning in 1934. Three species (Chrysolina hyperici, C. gemellata, and Agrilus hyperici) became established and have now controlled the weed in local areas.

In the United States, the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, and the Division of Biological Control at the University of California, have cooperated in introducing these three species of insects and others into northern California. Beginning in 1944, the insects were flown in from Australia, tested in their affinity for agricultural crops, and later released on St. Johnswort infested California ranges (33, 34, 35, 36, 45, 48). The two leaf-eating species (Chrysolina gemellata and C. hyperici) have multiplied rapidly and are now exerting considerable pressure on St. Johnswort in several localities where colonies have been established for four or more years. The root miner (Agrilus hyperici) is also well established, but because it does not multiply as rapidly as the other two is more restricted in distribution. Collections of all three insect species have been made at some of the early release sites, for redistribution both in California and adjacent states. Successful biological control of St. Johnswort in the coastal region now seems assured.

However, since climatic and other conditions in the interior region are somewhat different it is not yet definitely known which of the species now established in California will be best suited here. Several colonies of Chrysolina hyperici and a few of C. gemellata have been introduced into the interior for adaptability tests. These introductions have been under way since 1948. Agrillis hyperici has not been tested in this region yet because the individual insects are relatively difficult to collect. In general the Chrysolina colonies have been successful but a few have failed to become established. Chrysolina gemellata has given the most promise in northeastern Washington, northern Idaho, and western Montana. It was first thought that C. hyperici, a native of England, would be better adapted to the cold climate of the interior than C. gemellata, a native of southern France. Entomologists now believe that the latter species may be best adapted, principally because it requires less fall precipitation

to stimulate breeding and egg laying. While it is too early to draw final conclusions, successful biological control of St. Johnswort in the interior region seems promising (34).

Nevertheless, it is unlikely that these insects, even though they become well adapted to conditions in the western states, will ever eradicate St. Johnswort. Experience has shown that after an insect parasite has been propagated throughout a weed-infested region, a series of dynamic cycles ensues. Whenever insects reduce weed infestations drastically, the insect population is reduced by a lack of food. This stage in turn is followed by a build-up in weed density, and a subsequent increase in parasite population until the weed is again temporarily controlled. In a weed-infested region embracing several states there will undoubtedly be areas in various stages of control and expansion indefinitely (36).

Chemical control methods should be used to supplement entomological methods, even after the entomological program is successfully established. Chemicals are especially useful on small, isolated, infestations and in cases where immediate control is desired.

After control it is very important that ranges be restored by reseeding to a good condition, for poisonous and noxious weeds will continuously invade ranges which do not support a vigorous cover of good forage plants (37, 56).

## SUMMARY

St. Johnswort, a poisonous perennial weed introduced into the United States from Europe, now occupies more than two million acres of range land in California and the Pacific Northwest. Though poisonous to livestock, it seldom is fatal, but does great damage by reducing the grazing capacity of the infested range and by causing losses of weight and condition in the affected livestock.

Control of St. Johnswort is not as great a problem in Europe as it is in the western United States because it has numerous insect enemies there which reduce its vigor sufficiently to allow other vegetation to replace it except on newly disturbed areas. However, in western United States where the weed has been free of insect enemies and grazed but little, it has spread widely through range lands. The present infested area is small compared to the range area susceptible to invasion if the weed is left uncontrolled.

Complete eradication of this weed now seems impossible. Control methods must be cheap and effective, and control should include reseeding of treated range to cover the bare soil left by the removal of St. Johnswort.

Mechanical methods are unsuited for most infested lands because they are expensive and difficult to apply on rough, inaccessible ranges.

Borascu, an unrefined chemical, applied at the rate of 640 to 1,600 pounds per acre, followed by reseeding to adapted grasses has resulted in good control but costs $15 to $50 per acre. Use of 2, 4-D is cheaper and has given acceptable results in California but not in the interior region. More research is needed to improve the effectiveness of 2, 4-D application.

Forced overgrazing by livestock does not control St. Johnswort, but further damages the desirable forage plants growing with the weed and is detrimental to the animals. Moderate grazing by goats has controlled St. Johnswort, but goat grazing is too limited to effect control over the extensive acreages now occupied.

In Australia, plantations of Monterey pine have held out the weed except in freshly disturbed areas. However, the planting of trees would not be practical on much of the western range.

Widespread propagation and distribution of insect enemies of St. Johnswort seems to offer the cheapest control. Australian entomologists pioneered this work and have furnished this country with three St. Johnswort consuming insects (Chrysolina hyperici, C. gemellata, and Agrilus hyperici) for planting. All three are now established in the coastal region and are controlling St. Johnswort in limited areas. Colonies of these insects were planted in Washington, Idaho, and Montana in 1948, 1949, and 1950. Progress has been encouraging but it is too early to judge success. Eventual control depends upon the use of chemicals, insects, and other methods where applicable followed by reseeding and good range management. Further spread of St. Johnswort in the interior region can be restricted by use of proper stocking rates and other good range management practices on all range lands.

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